

Development of high brightness and high average power picosecond thin disc laser for short wavelength light sources in HiLASE project (S24)

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The HiLASE Project

- HiLASE: High average power pulsed LASErs
- European project on strategic development of advanced solid-state laser technologies based on diode pumping (thin-disk laser, multi-slab laser)
- Potential for novel industrial applications using pulsed, high-energy & high-average power DPSSL

2011/9 2015/9

2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017

Implementation Phase → Operation Phase



Demonstration / Technology Transfer

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Present Status of HiLASE Facility

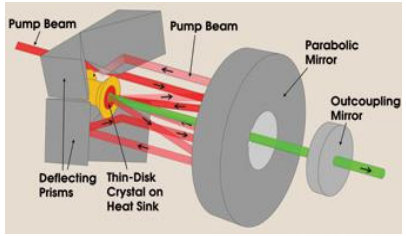








Thin Disk-Based High Power Picosecond Laser Beamlines in the HiLASE Project



Beamline-A

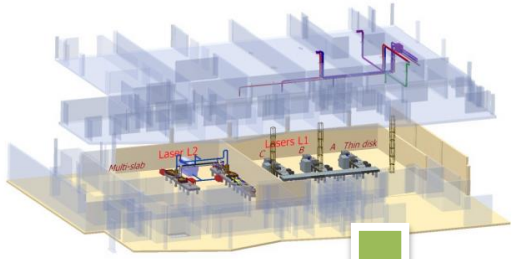
0.75 J, <3 ps, 1.73 kHz

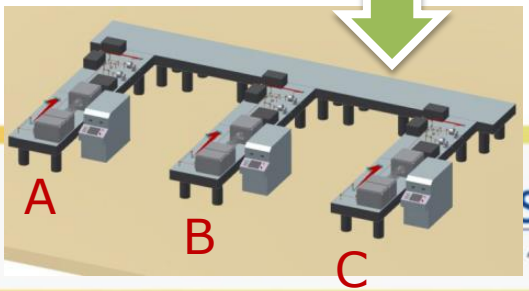
1.3 kW

Sub-contract

100 mJ, 1-2 ps, 1 kHz

100 W





Beamline-B

Oscillator

Pulse stretcher

Pre

Regenerative Amplifier

Main

Ring amplifier

Pulse compressor

0.5 J, 1-2 ps, 1 kHz

500 W

Beamline-C

Oscillator

Pulse stretcher

Main

Regenerative Amplifier

Pulse compressor

5 mJ, 1-2ps, 100 kHz

500 W

Booster

Cryogenic Slab amplifier

Pulse compressor

1 J, 1-2 ps, 120 Hz

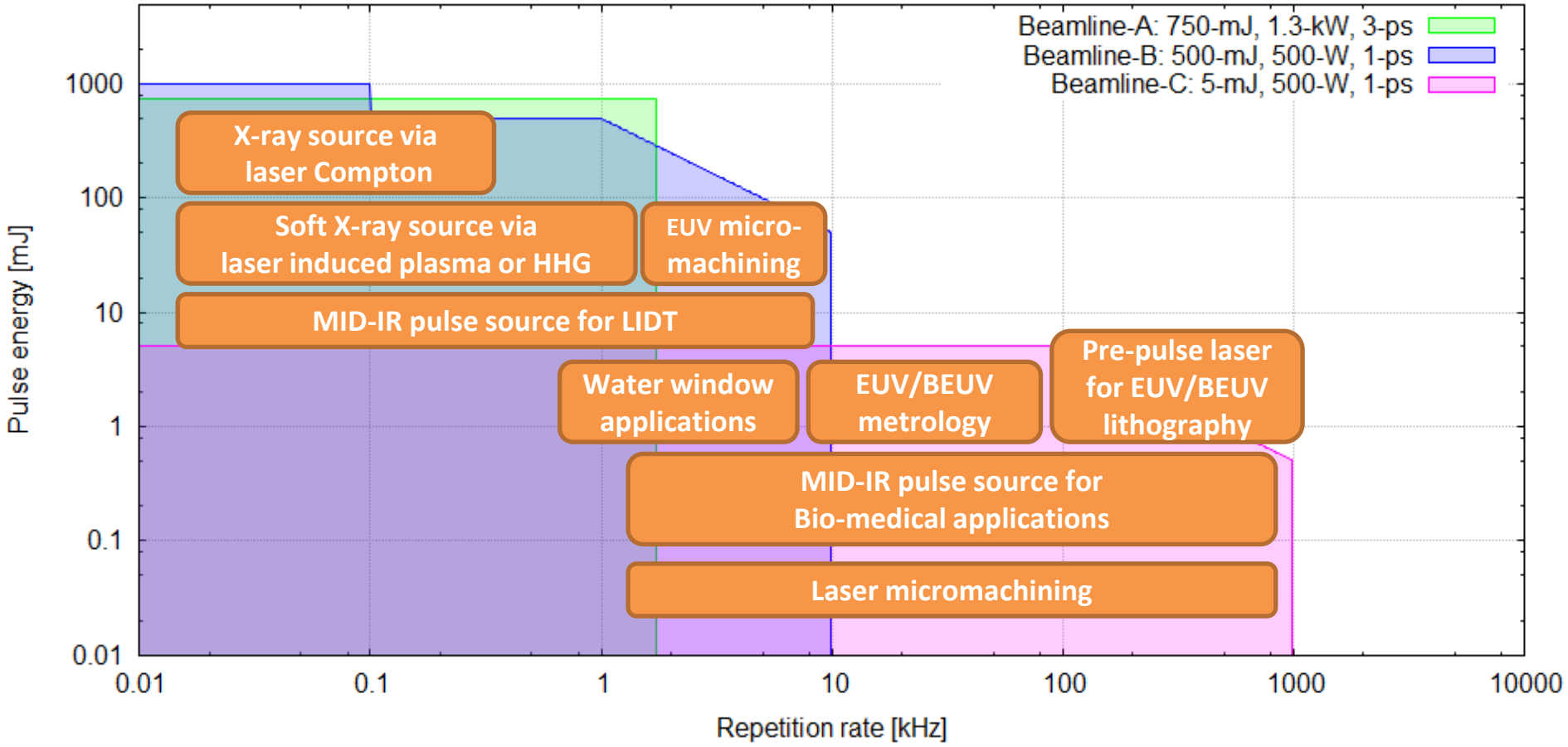
120 W

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Until Sep. 2015

Industrial and Medical Applications Using High Energy Picosecond Pulse Based on Thin Disk Technology



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During the Building Construction



HiLASE

Dolni Brezany



- Area of future **R&D centres** south of Prague city, enjoyable surroundings
- **Synergy** with **ELI** (on site) and biotechnology center **BIOCEV** (at 2 km distance)
- **Short** connection **(20 min.)** to Ruzyne **international airport**

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Present Status of Beamlines Development





Beamline-B
Beamline-C

45-mJ, 1-kHz

30-mJ, 1-kHz

50-W, 10-kHz

May 2013
Dec. 2012

Nov. 2012

50-W, 100-kHz

May 2013
Apr. 2013
Jan. 2013

25-W, 100-kHz

Pulse energy [mJ]

1000
100
10
1
0.1
0.01

0.01 0.1 1 10 100 1000 10000

Repetition rate [kHz]

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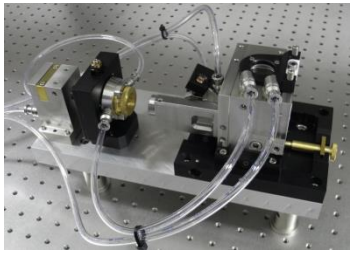
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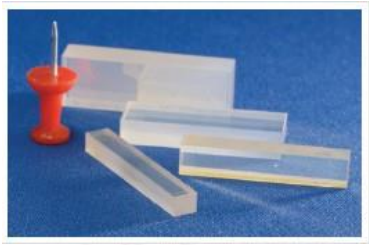
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High Repetition Rate Regenerative Amplifier

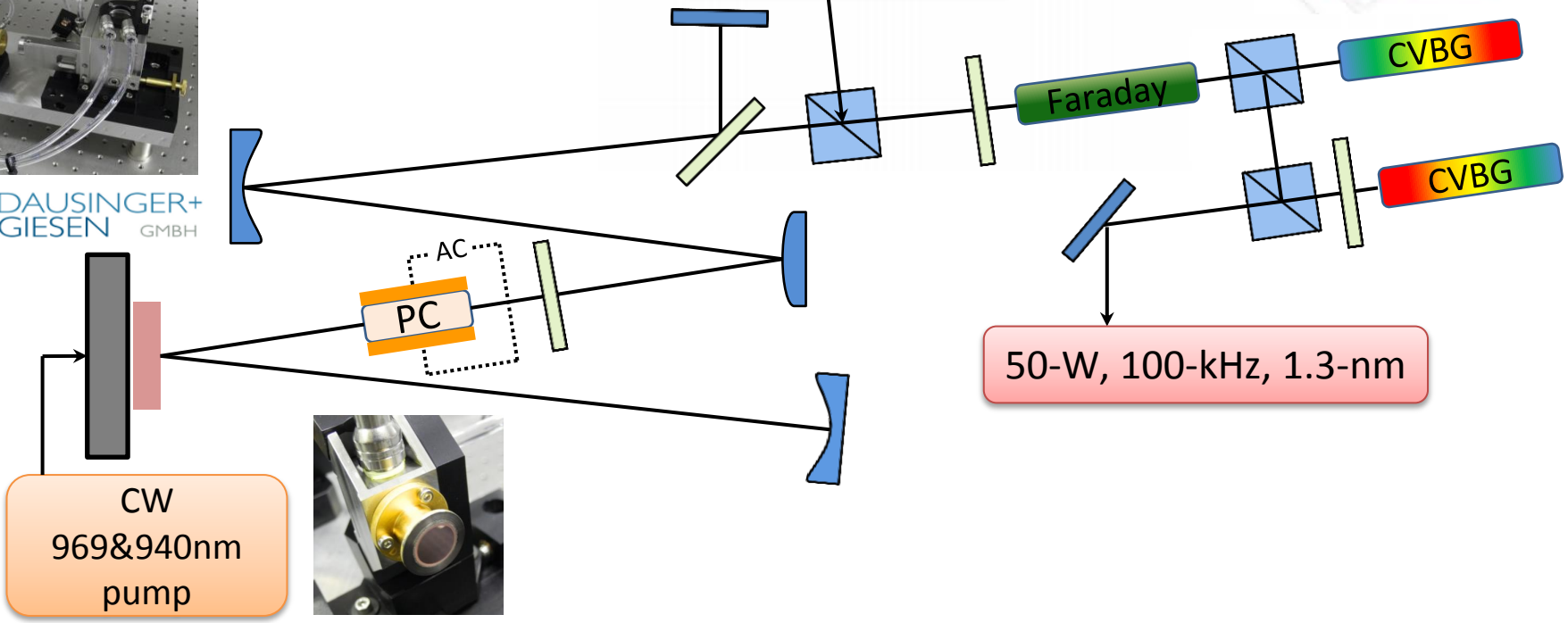
Beam Line C



DAUSINGER+ GIESEN GMBH



OptiGRATE HIGH EFFICIENCY FOR HIGH POWER



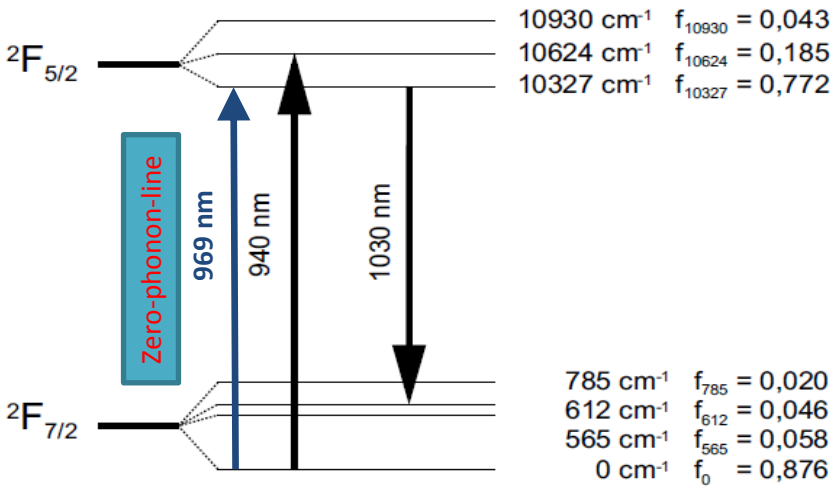
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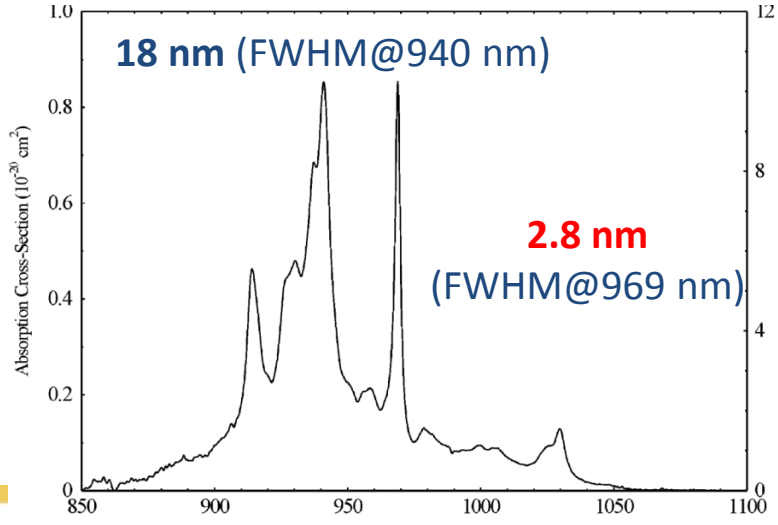
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Pumping at Zero-Phonon-Line of Yb:YAG



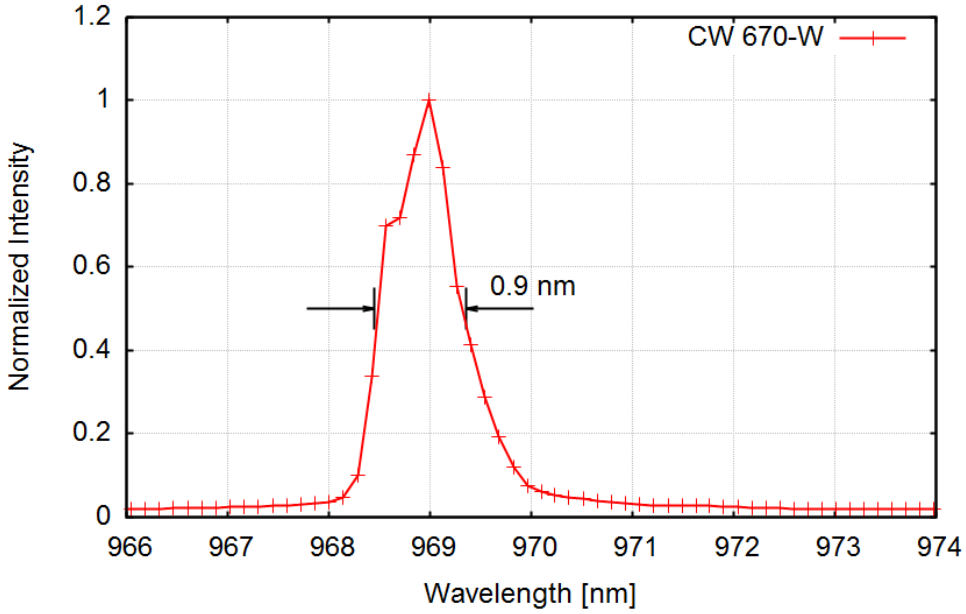


Quantum defects

8.7 % @ 940 nm

5.9 % @ 969 nm

Wavelength stabilized laser diode by using Volume Bragg Grating (VBG)



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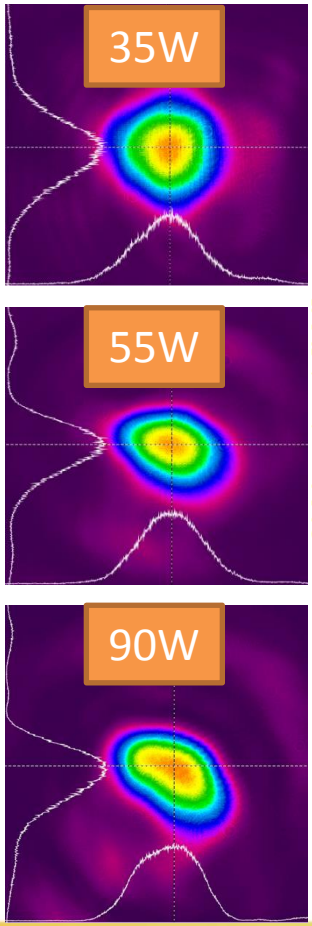
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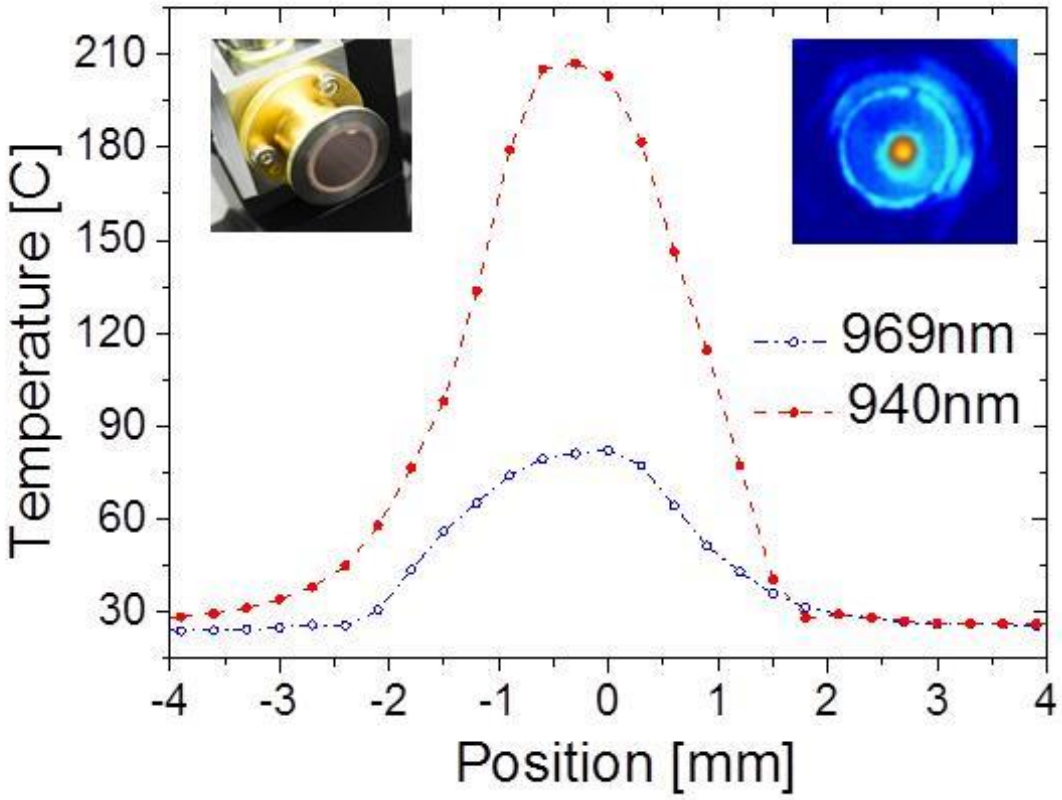
Characteristics of CW Output

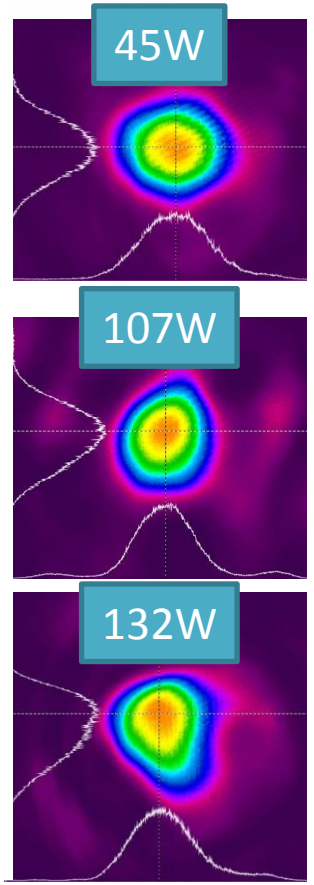
940-nm pump

CW output without Pockels cell

969-nm pump







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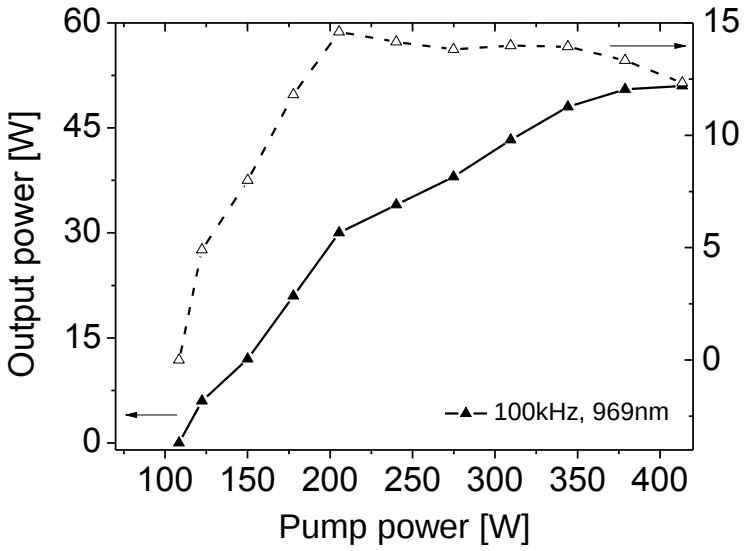
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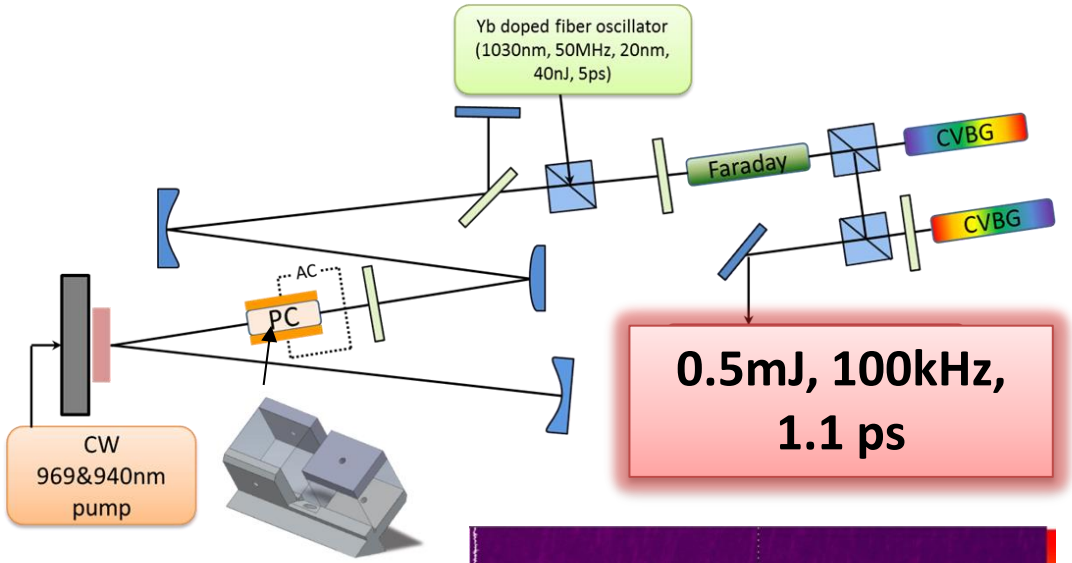
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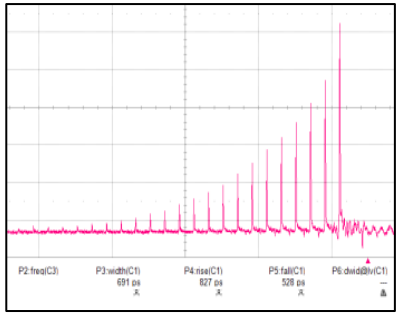
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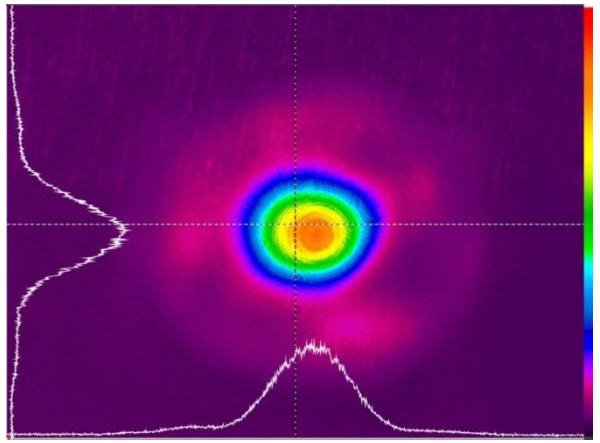
52W, 100kHz-Regenerative Amplifier

- 2.3nm bandwidth
- 32% slope efficiency
- 15% optical-optical eficiency
- 2.8mm pumpspot (diameter)
- 91 roundtrips
- 100kHz/0.5mJ after compression
- 2.55m cavity length

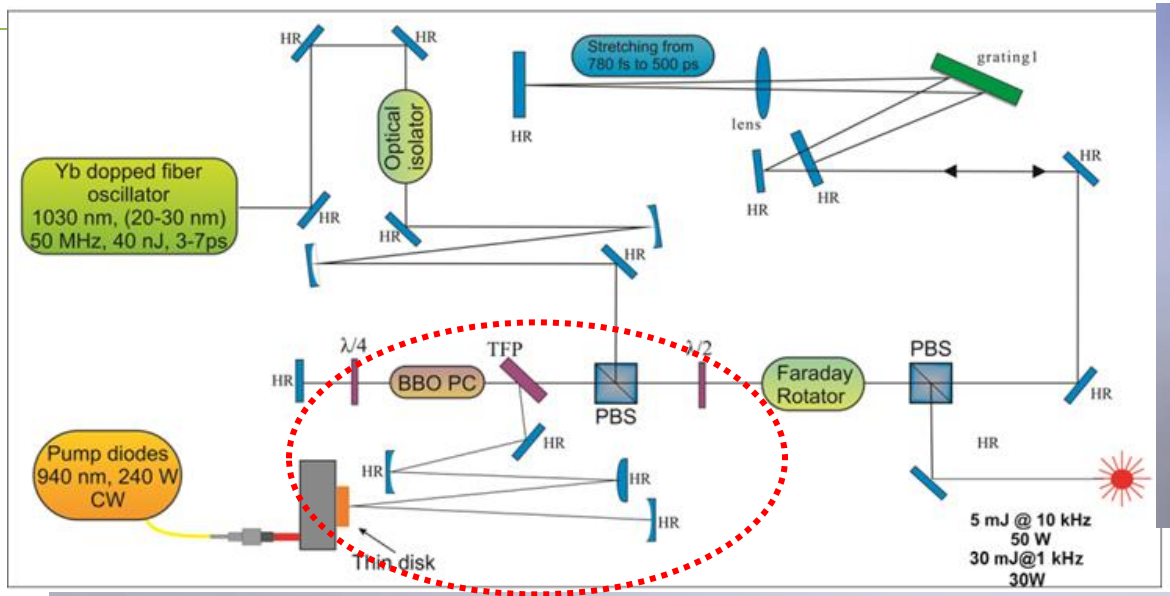


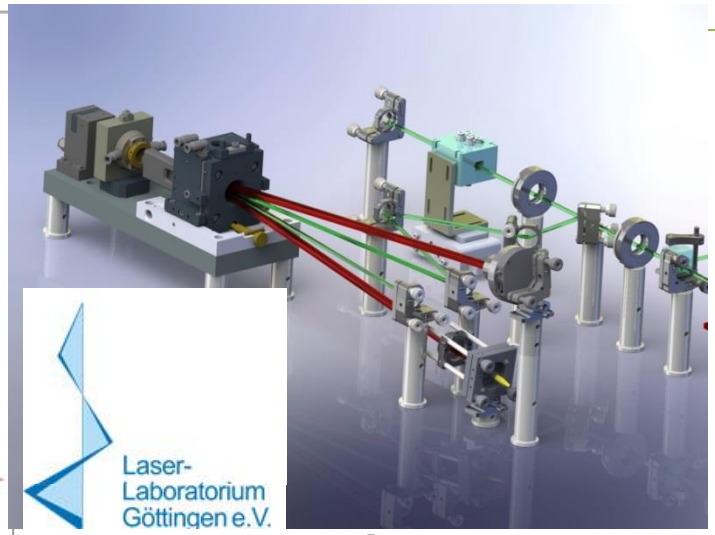


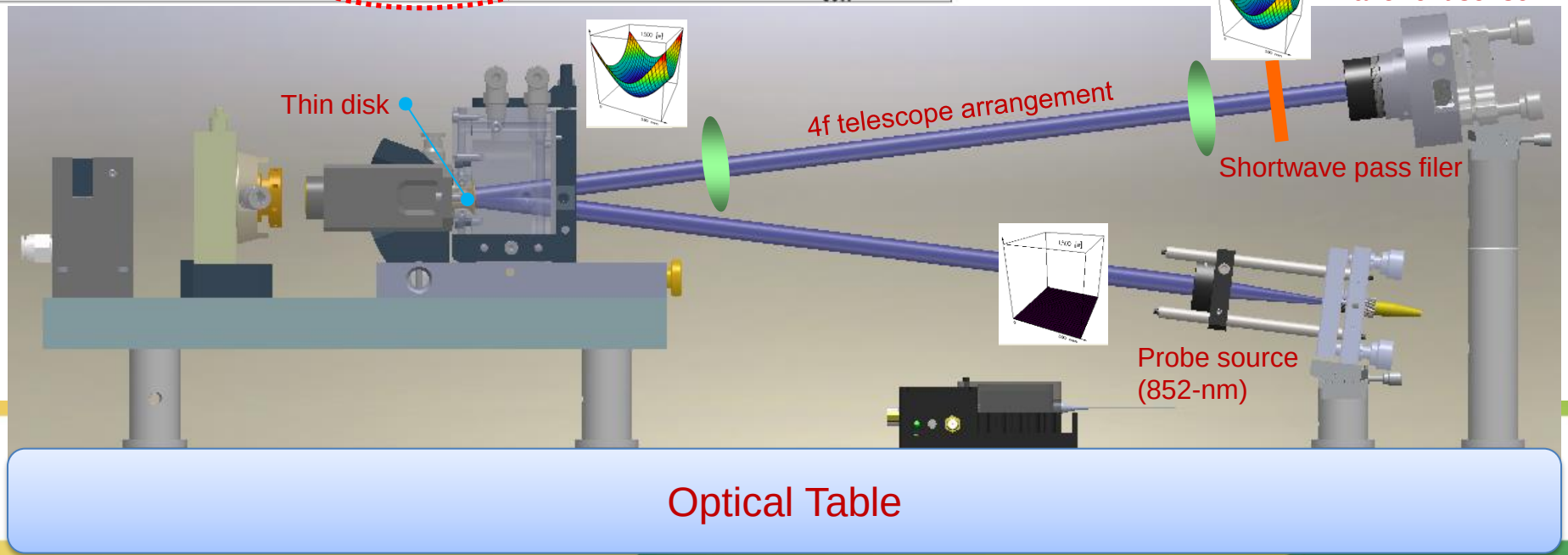




Experimental Setup of In-situ Thin Disk Deformation Measurement



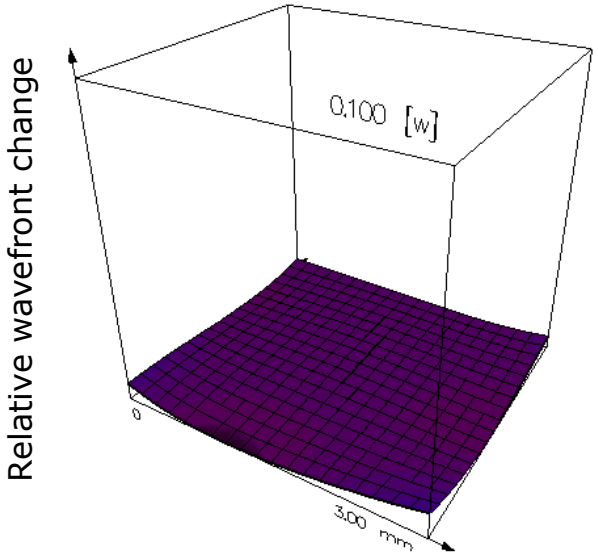




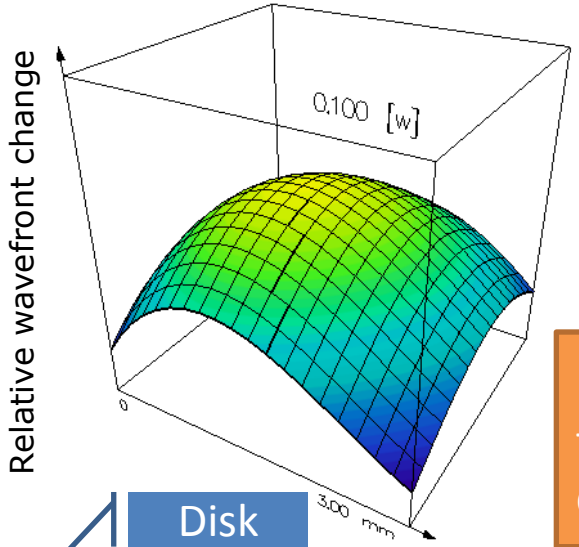
Optical Table

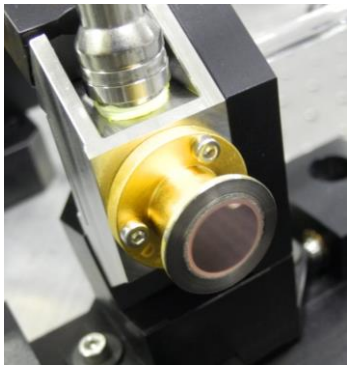
Precise Measurement of Thin Disk Deformation

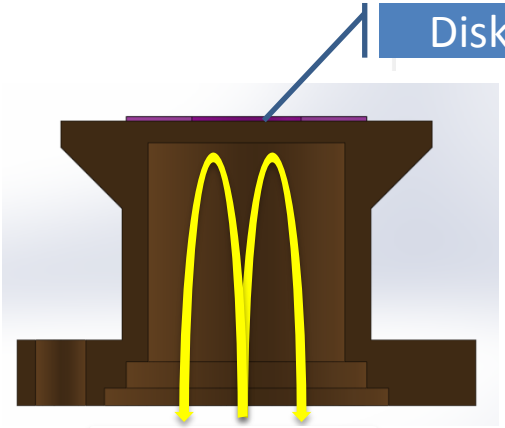
Cooling water: Off



Cooling water: On



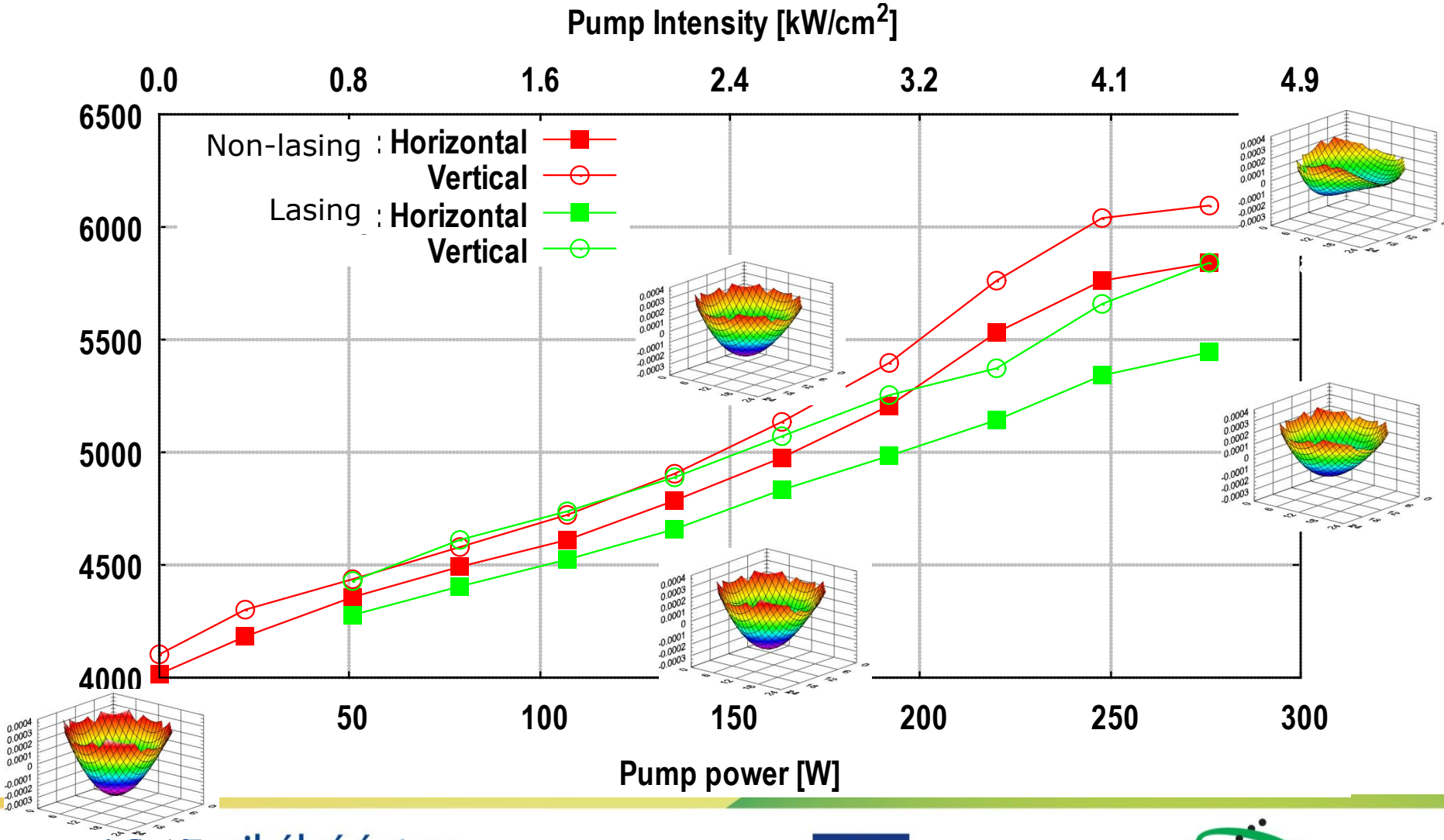




Displacement less than 40-nm can be detected.



Cylindrical Deformation of Yb:YAG Thin Disk Under The Lasing Operation



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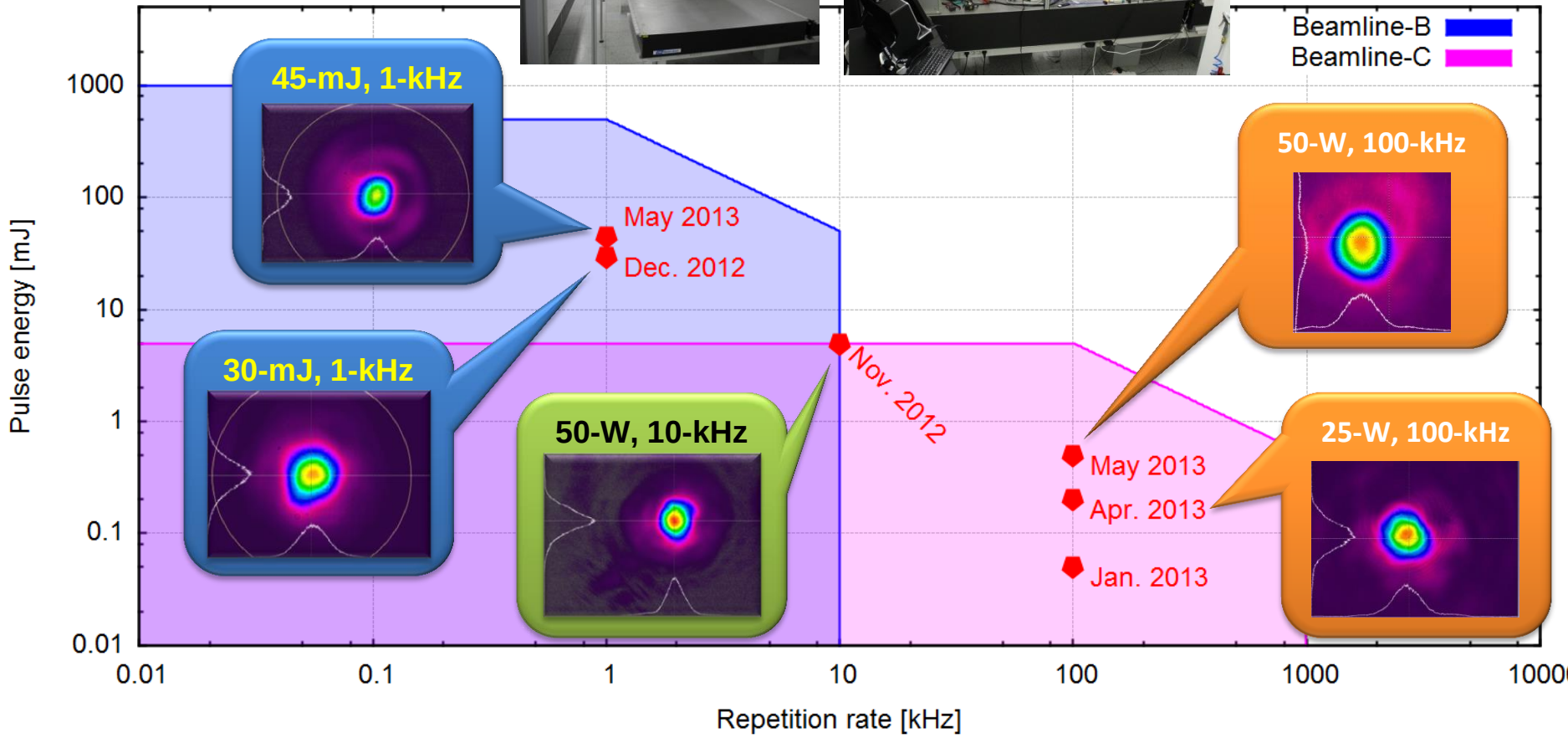
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Present Status of Beamlines Development







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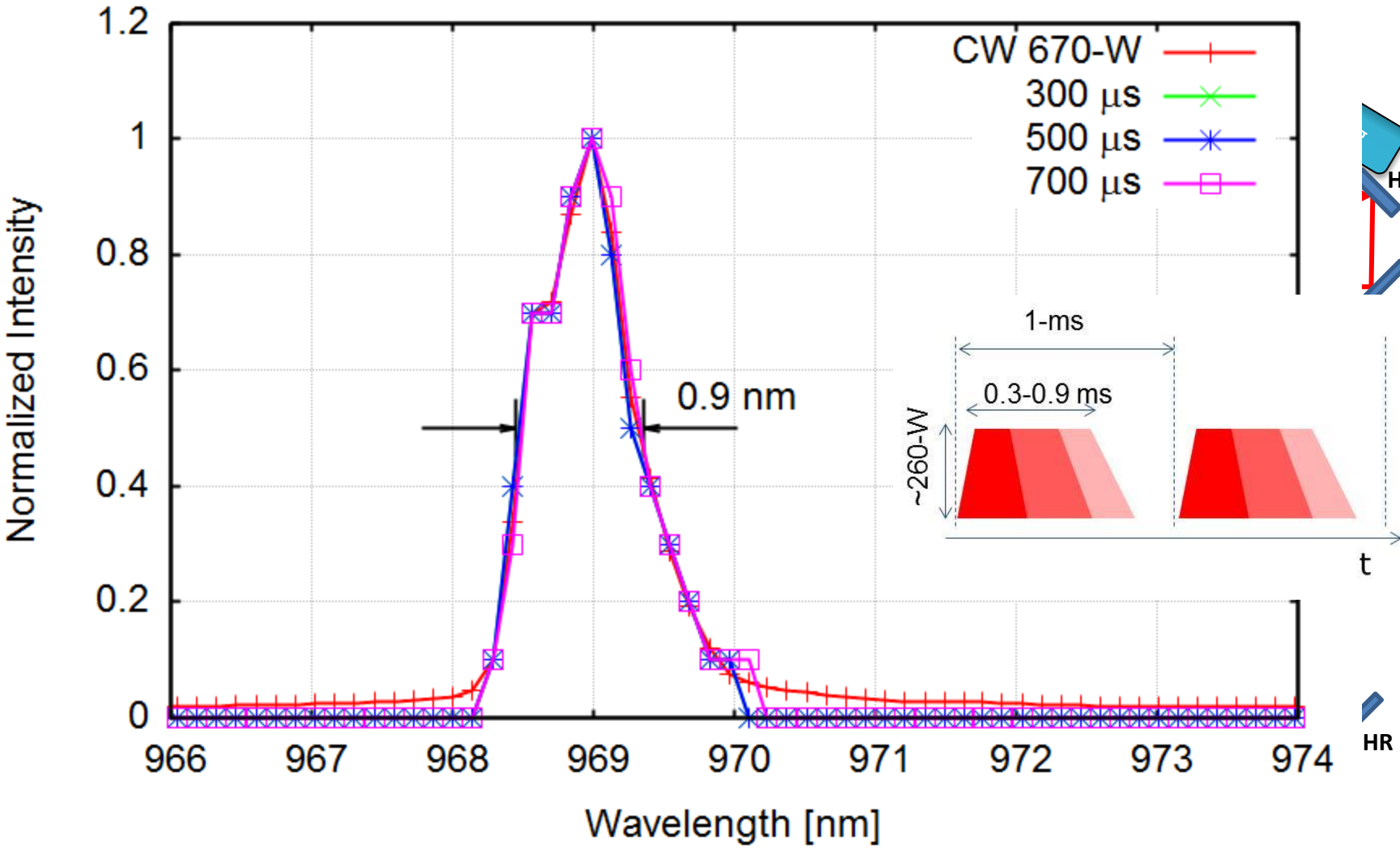
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Beam Line B

High Energy Regenerative Amplifier
With pulsed zero-phonon-line pumping



HR
CAV
VEX
HR
HR

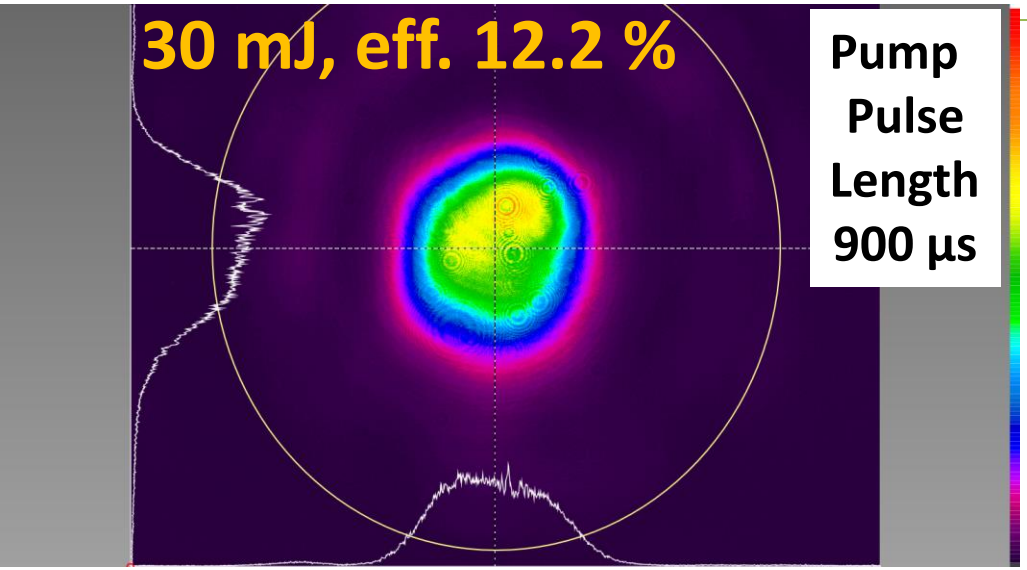
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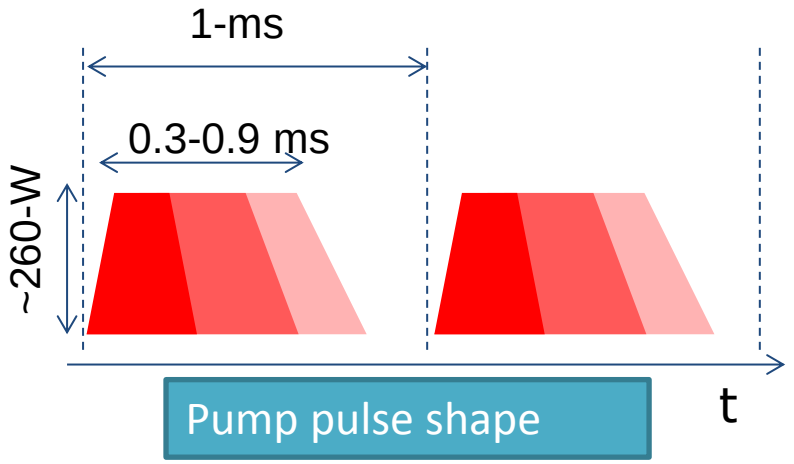
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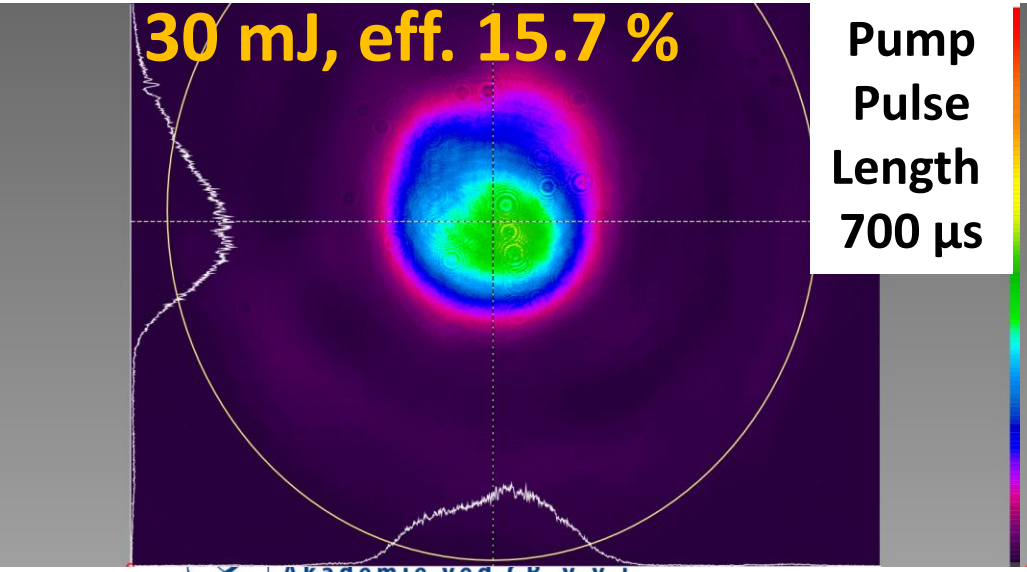
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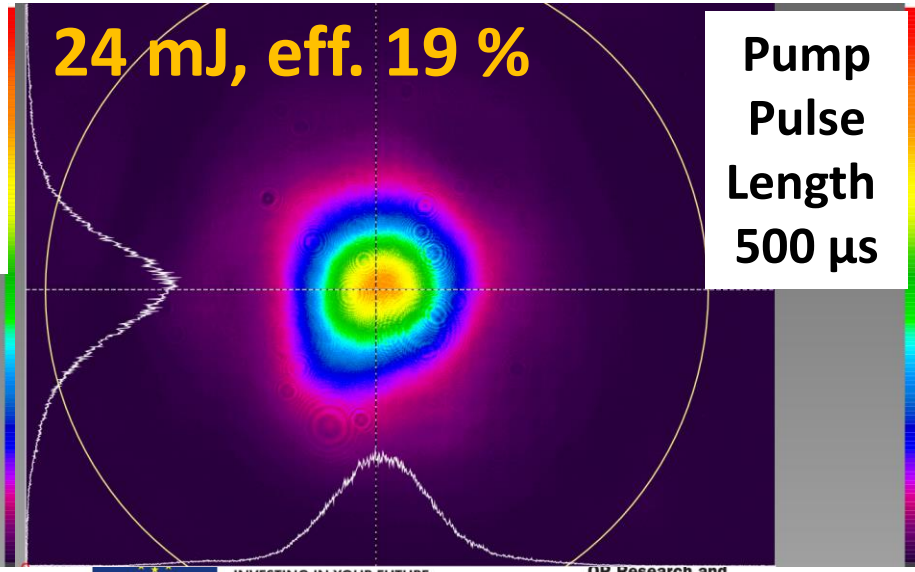
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Pulsed Pumping in 1-kHz Regenerative Amplifier







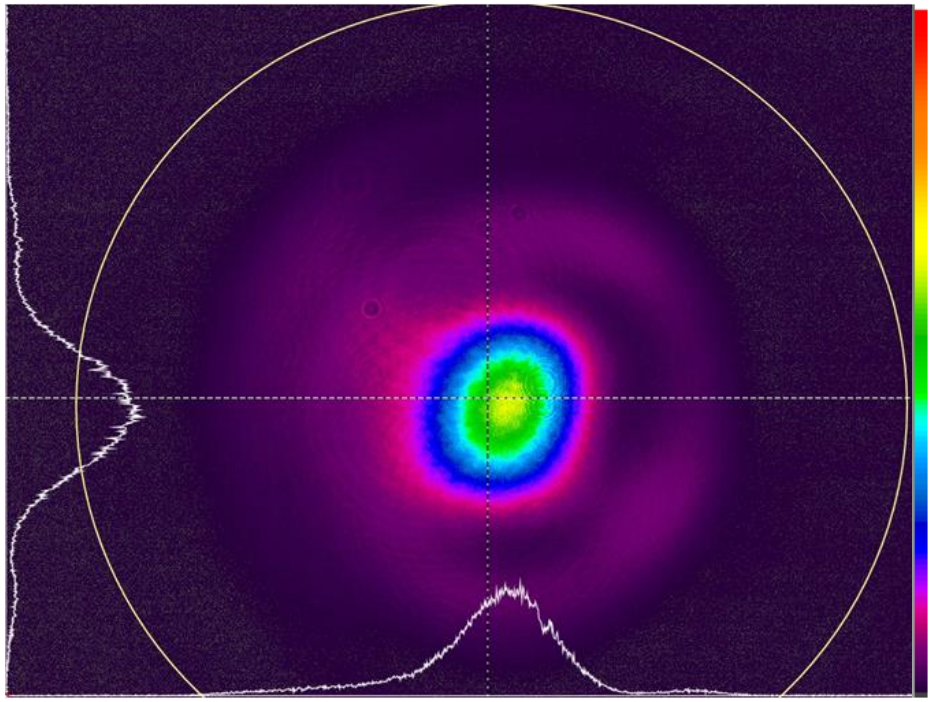


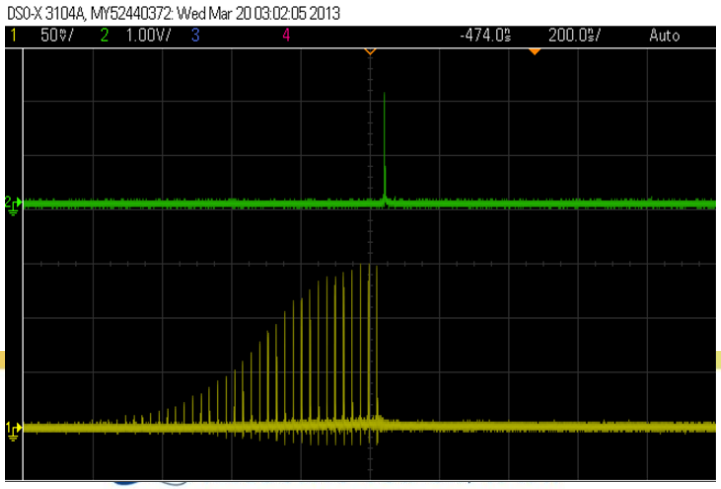
Beam Line B

45-mJ Output with 1-kHz, 0.5-ms Pulsed Pumping at 969-nm



~20% O-O efficiency

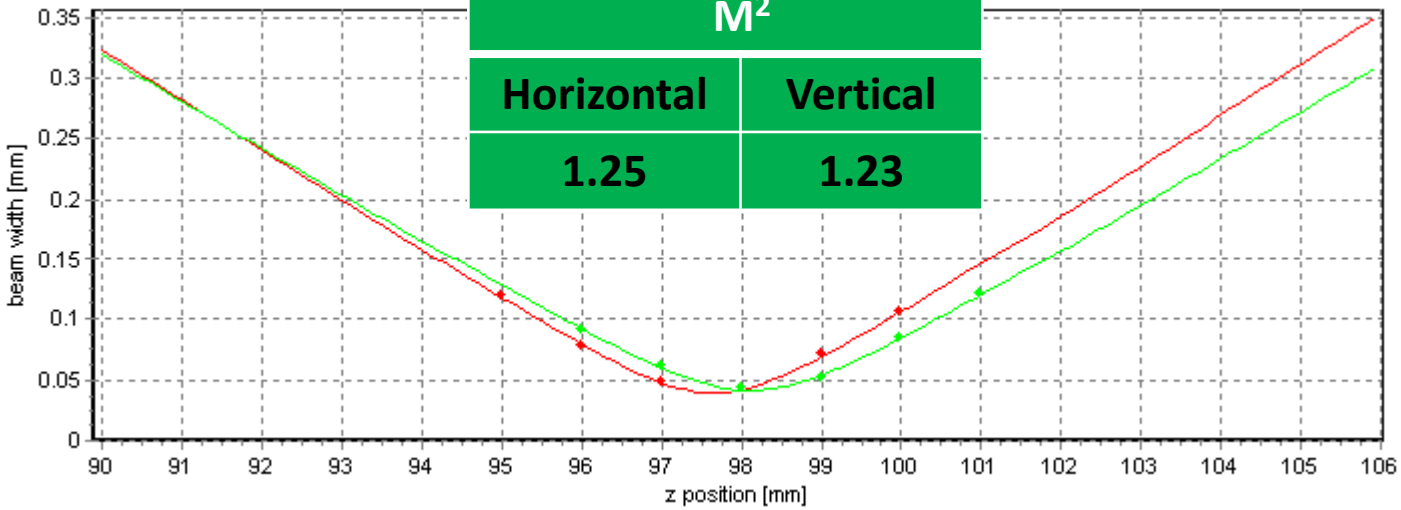


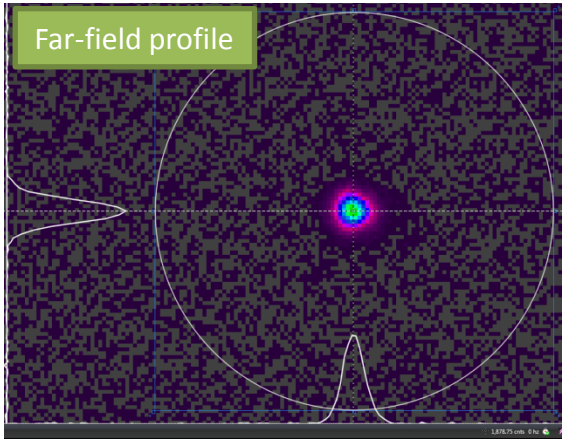


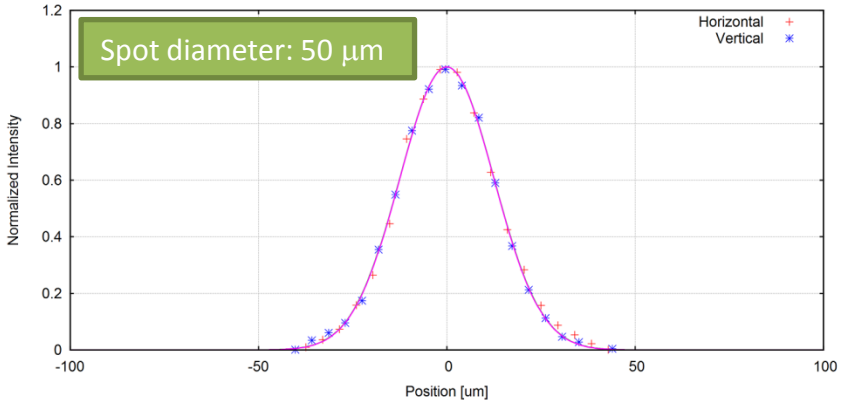
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M^2 measurement of HERA

M^2	
Horizontal	Vertical
1.25	1.23







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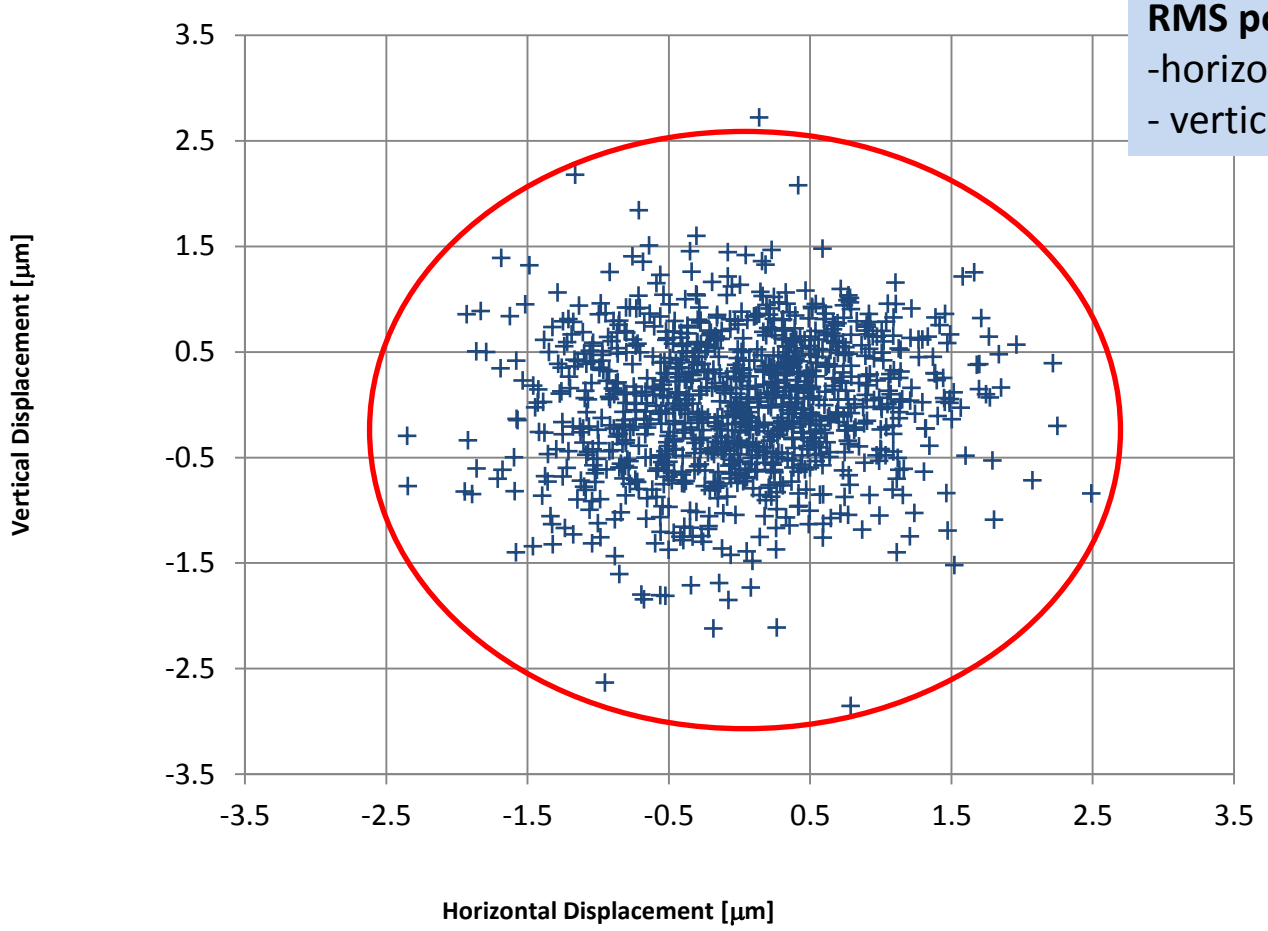
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Beam Line B

Beam pointing stability

hilase

RMS pointing stability:
-horizontal: **3.8-µrad**
- vertical: **3.3-µrad**



Measurement time: **15 min**

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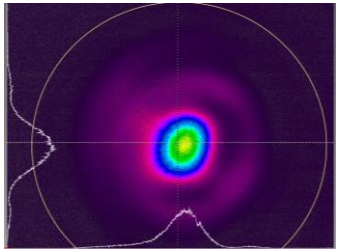
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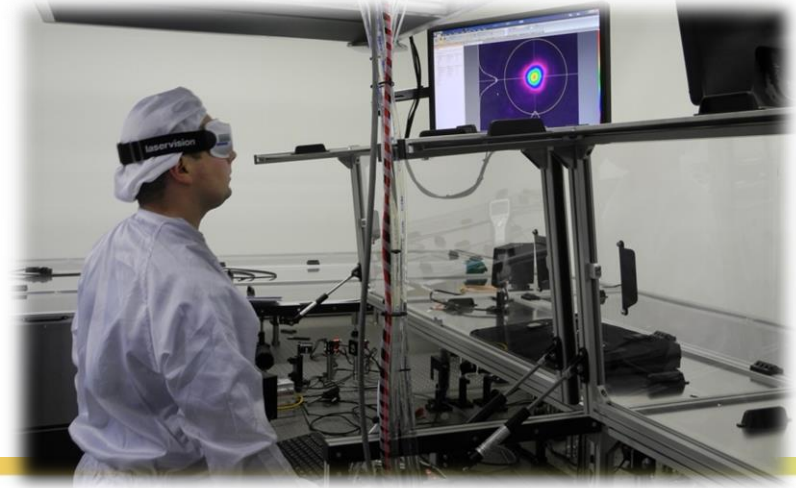
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Summary

- Overview of the HiLASE Project
- Present status of thin disk laser development
 - Beamline-B: 45-mJ, 1-kHz (Pulsed pumping)
 - Beamline-C: 52-W, 100-kHz
- Beam quality: $M2=1.25_X/1.23_Y$
- RMS pointing stability: $3.8\text{-}\mu rad_X/3.3\text{-}\mu rad_Y$







http://hilase.cz/en

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